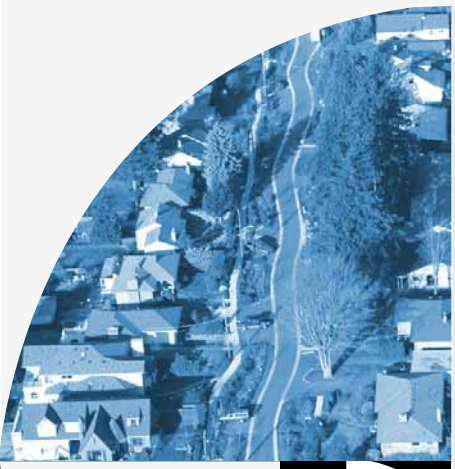
Sustainable Travelways

"Green Streets" Administrative Guidelines



May 3, 2006

"Growth is inevitable and desirable, but disruption of natural capital and community character is not. The question is not whether your part of the world is going to change. The question is how."

- Edward McMahon, *The Conservation Fund*

FUSCOE ENGINEERING

full circle thinking

Sustainable Travelways
"Green Streets" Administrative Guidelines

Traditionally, public streets have been designed for more traffic at a faster pace with permanent consequences to the quality of our environment and sense of place. Drainage in these streets has been collared into underground pipes starving the landscaping, groundwater aquifers, and bypassing the natural cleansing of the infiltration process. Large expanses of heat producing, impervious surfaces have contributed to a cumulative deterioration of our atmosphere and deprived otherwise productive soil of oxygen and nutrient building water. This approach has depleted our natural capital at the expense of future generations.

Recognizing these consequences, The City of Irvine Redevelopment Agency has set out to prepare guidelines which provide for more environmentally sustainable public streets in the Great Park Community (GPC). The concept that streets are a public realm for all to enjoy, as well as the place to initiate sustainable designs to be carried into adjoining developments, have guided this effort. Through a series of workshop sessions, the Green Streets Technical Committee made up of County and City stakeholders collaborating with Design Professionals have crafted a set of twelve (12) categorical "features" along with definitions and OCFA appendices. The Green Streets Technical Committee began this effort to improve the ecological value of the land that is utilized for public travel ways. The goal of providing cleaner water and air, higher biological value, lower energy use, and resilience in the design of streets was adopted. The twelve features have been compiled into a catalog to be used by Developers and Builders in the "Great Park Community" more specifically Orange County Great Park and Heritage Fields to be considered for incorporation into final design and construction, these features stipulate a standard to be considered while inviting creativity for the final application.

The Green Streets Technical Committee understands the importance of allowing the planners, designers, developers, and builders of THE GREAT PARK and HERITAGE FIELDS to exercise creativity and temper these Sustainable Guidelines to fit specific site circumstances yet to be defined. Therefore the City Redevelopment Agency is not making these binding standards but rather design guidelines to be considered by design professionals where appropriate for progressive and proven features that will help transform the Great Park Community into a 21st Century place to live, work, and play.

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The Green Streets Technical Committee

(From Left: Mark McKeehan, Nancy Foreman, Eric Tolles, Mike Hoolihan, Pat Fuscoe, Bret Petroff, Tina Christiansen, Mark Carroll, Vahid Toosi, Dianne Parker, Drew George)

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Sustainable Travelways "Green Streets" Administrative Guidelines

TABLE OF CONTENTS

1. ENHANCED TREE CANOPY

Capabilities

- Shade and Heat Reduction
  - Reduce ambient air temperatures responsible for Heat-Island Effect (Figure 1.1)
  - Reduce ground thermal pollution by maintaining moisture within soil
- Air and Water Quality Improvement
  - Direct removal of carbon dioxide, nitrogen oxides, sulfur oxides, ground-level ozone, and particulate matter
  - Reduce air pollutant emissions from energy requirement savings
  - Increase water quality through foliage and root filtration
  - Increase evapotranspiration
- Reduce energy demand for indoor air conditioning
- Erosion Control
  - Rainfall interception reduces raindrop impact and erosion by 17%
  - Increase soil stability from tree root structure
- Wind and Noise Buffer
- Improve Aesthetic Beauty – "street as public place"
  - Increase property value
  - Increase safety

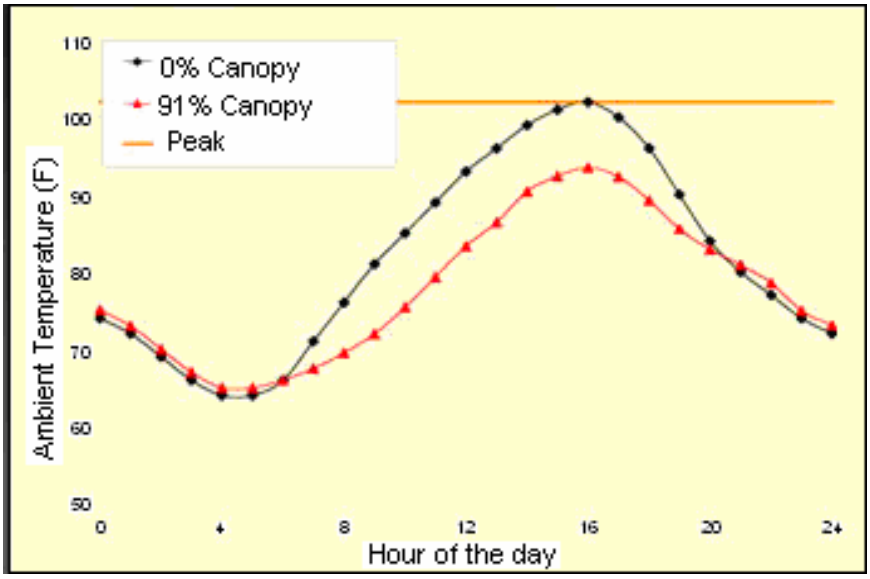


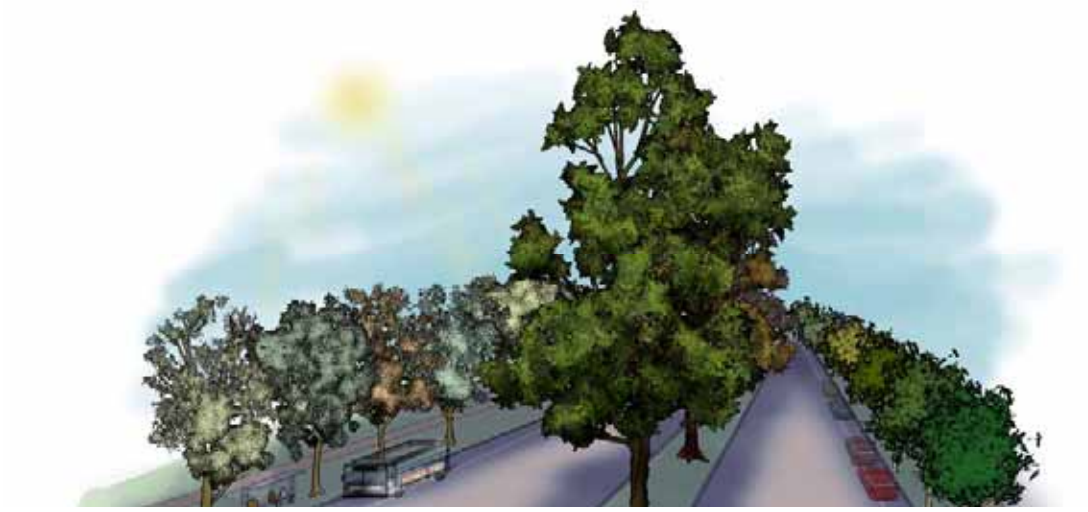
Figure 1.1

Information

- Up to 20°F reduction in ambient air temperature from shade
- Up to 36°F reduction in surface asphalt temperatures and 47°F reduction in vehicle cabin temperature[1]
- Planted trees may reduce summer cooling costs 20-40%[2]
- Up to 20% increase in property value from addition of trees (average 5-7%)[3]
- Consumer ratings of retail establishments were up to 80% higher for business districts with street trees and other landscaping[2]

Application Criteria

- "Urban Forest" grouping and linear arrangements
- Incorporate a diverse, stratified plant structure for "Urban Forest" grouping
- Plan for fire truck clearance/access
- Tree spacing, species, groupings, maintenance techniques and frequencies shall consider fire spread potential
- Plan for root and canopy footprint
- Careful placement and spacing near underground sewers
- Locate on swale impoundments to avoid flowline blockage
- Engineered media and "structured soil" for root containment
- Maintenance responsibility and incremental costs by landscape district



Enhanced Tree Canopy

[1] USDA Forest Service: Center for Urban Forest Research. *Effects of Tree Cover on Parking Lot Microclimate and Evaporative Hydrocarbon Emissions from Parked Vehicles*. Jun 28, 2005 USDA Forest Service. Mar 17, 2006. http://www.fs.fed.us/psw/programs/cufr/research/air.shtml

[2] California Energy Commission. *Landscape Now and save energy the natural way.* March 17, 2006. http://energy.ca.gov/efficiency/home_energy_guide/LANDSCAPING.PDF

[3] Center for Watershed Protection. 2005. *Urban Watershed Forestry Manual Part 2: Conserving and Planting Trees at Development Sites*. Center for Watershed Protection, Ellicott City, MD.

Trabuco Road Entry
to Great Park

Enhanced Tree Canopy

2. LOW VOLUME IRRIGATION

Capabilities

- Reduced water consumption
  - Improved delivery efficiency (less overspray and wind losses)
  - Utilize recycled water
- Reduced runoff and pollution potential
- Improved landscaping health
- Reduce energy pumping costs
- Reduce construction defects from overspray

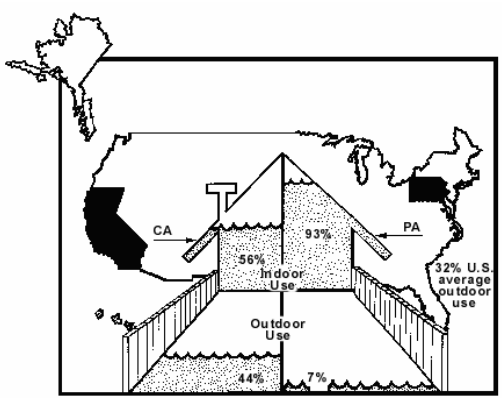


Figure 2.1

Information

- 55%-60% of total water usage in Orange County is for landscape irrigation[1]
- "Landscape irrigation [is] the single greatest waste of water in Orange County"[1]
- Up to 59% reduction in outdoor water usage possible[2]
- Up to 71% non-point source runoff reduction possible[2]
- Overwatering can lead to plant disease problems, poor soil aeration, wet soil beneath benches, standing water and other cost impacts.[3]

Application Criteria

- Engineered substrate to convey irrigation percolation to specimen trees in deep wells
- Consider subsurface delivery system
- Utilize telemetric "smart" controllers such as weather controlled irrigation systems
- Consider and accommodate specialized maintenance requirements

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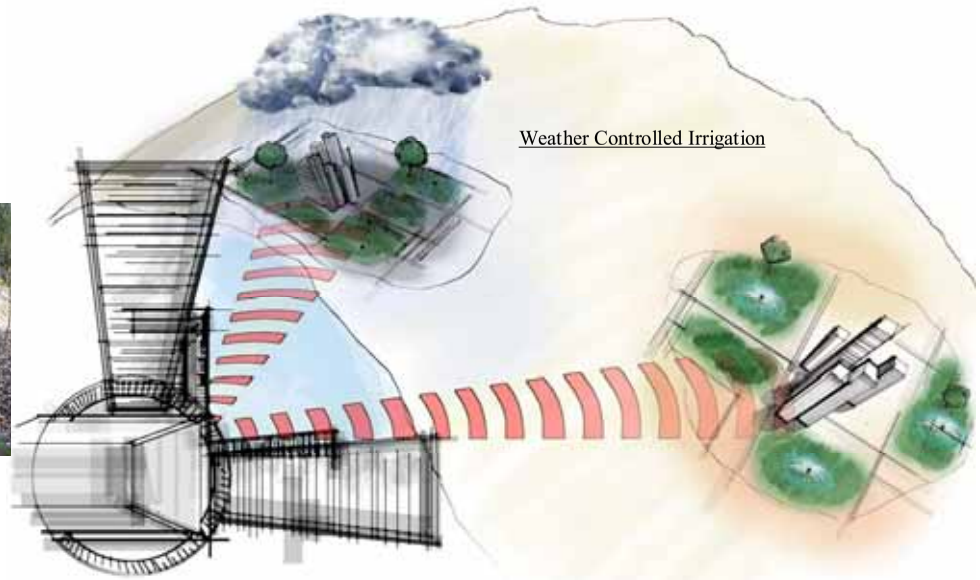
[1] Orange County Water District. As Drought Continues, Residents, Businesses Urged to Use Less Water, Especially for Landscape Irrigation. Press Release, Oct. 1, 2004. Orange County Water District March 21, 2006. http://www.ocwd.com/_html/_pr/_pr04/pr04_1001drought.htm.

[2] HydroPoint Data Systems. *WeatherTRAK® Smart Irrigation. Made Simple.* 2003

[3] University of Connecticut Cooperative Extension System. *Greenhouse Pesticide Management: Pesticide Applicator Manual: Private Greenhouse*. 1996 http://dep.state.ct.us/wst/pestcert/applicator/greenhouse_manual.pdf. Connecticut Department of Environmental Protection. March 22, 2006.

Low Volume Irrigation



Weather Controlled Irrigation

Spray Irrigation
(Inefficient)

Stream Irrigation
(Correct)

3. PERMEABLE PAVEMENTS AND SURFACES

Capabilities

- Reduce runoff
- Utilize infiltrated runoff for landscape
- Restore groundwater
- Improve water quality (TSS, P, N, Temp., etc.)
- Reduce ambient air temperatures responsible for Heat-Island Effect
- Reduce costs associated with storm drain infrastructure
- Reduce costs with reuse of "El Toro Stone" (see definition Section 13) to define travelways, and as paving material.
- Improve aesthetic paved surfaces for "Streets as Public Places"

Information

- up to 90% reduction in runoff volume[1]
- Possible removal of 82-95% of sediment, 65% of total phosphorous, and 80-85% of nitrogen from runoff[2]
- 2-4°C reduction in surface runoff temperatures[1]
- "Permeable pavements are up to 25 % cheaper (or at least no more expensive than the traditional forms of pavement construction), when all construction and drainage costs are taken into account."[3]

Type of Surface	Factor C
Watertight roof surfaces	0.75 to 0.95
Asphalt pavements	0.80 to 0.95
Concrete pavements	0.70 to 0.90
Gravel or macadam pavements	0.35 tp 0.70
Impervious soils (heavy)	0.40 to 0.65
Impervious soils, with turf	0.30 to 0.55
Slightly pervious soils	0.15 to 0.40
Slightly pervious soils, with turf	0.10 to 0.30
Moderately pervious soils	0.05 to 0.20
Moderately pervious soils, with turf	0.00 to 0.10

Figure 3.1

Application Criteria

- High performance porous concrete in travelways with group A or B soils or engineered infiltration
- Enable "drive over" median breaks for fire/police turnabouts
- Engineered paver blocks in parking, pedestrian and low volume trafficways
- Drivable grass or planted block grids only on level, very low traffic corridors and event parking areas or utility easements.
- Pavers, soil cement, decomposed granite, or "El Toro stone" trails and pathways for pedestrians
- Use of recycled concrete for onsite production of permeable pavers or as "in-place" stepping stones for pathways.
- Street intersection "calming bulbs," tapers, and crosswalks with permeable materials for pedestrian use.
- Consider curbless edges or panel curbs for more uniform runoff to adjoining parkways and median bio-swales for water quality treatment.
- Engineer base materials to meet infiltration requirements
- Meet ADA and Title 24 requirements at path of travel

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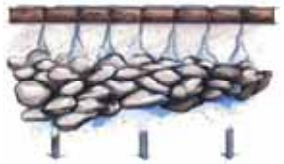
[1] James, W., 2002: Green roads: Research into Permeable Pavers. *Stormwater*, (March/April), 48-50.
[2] United States Environmental Protection Agency. *Stormwater Technology Fact Sheet: Porous Pavement.* Sept 1999. U.S. EPA. March 18, 2006. http://www.epa.gov/owm/mtb/porouspa.pdf
[3] California Stormwater Quality Association. *Pervious Pavements SD-20.* California BMP Handbooks. February 20, 2006. http://www.cabmphandbooks.com/Documents/Development/SD-20.pdf

Permeable Pavements



Infiltration used for restoration of groundwater

Infiltration collected into storm drain pipe to avoid groundwater contamination in environmentally sensitive areas

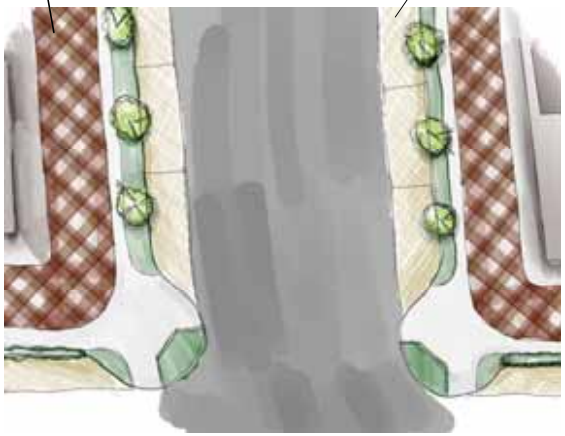
Grass Paver Fire Lanes

Parking Stalls With Permeable Pavers / Pavement

Sidewalks With Permeable Pavers

Street With Permeable Pavers / Pavement

El Toro Stone – Road Edge Treatment



4. USE OF RECYCLED MATERIALS

Capabilities

- Utilize on-site sources to reduce haul distance, disposal costs, and truck traffic
- Reduce production energy and materials cost
- Minimize imported chemicals and materials
- Increased lifespan of product

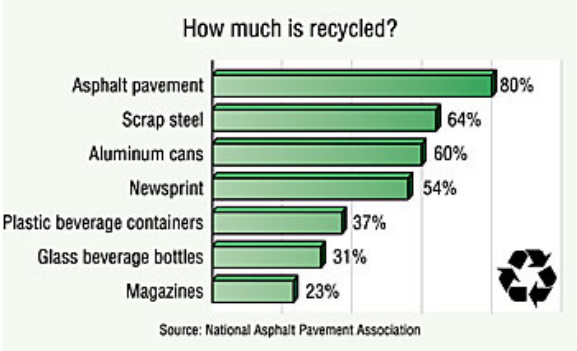


Figure 4.1

Information

- 5996 tons of concrete can be reclaimed from 1 mile of concrete pavement[1]
- 200 miles of concrete are recycled each year[1]
- Disposal fees of concrete can reach $100 per ton[1]
- Transportation fees of concrete are ~$0.15 per ton per mile[1]
- 44 states now use recycled concrete as a road base[1]

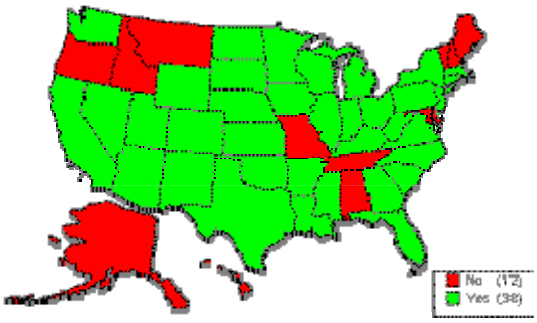


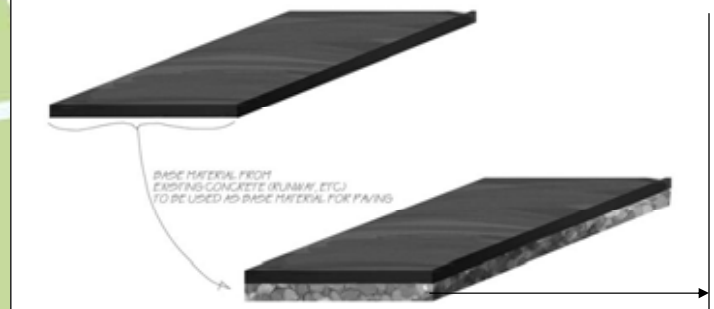
Figure 4.1: States using recycled concrete as aggregate base

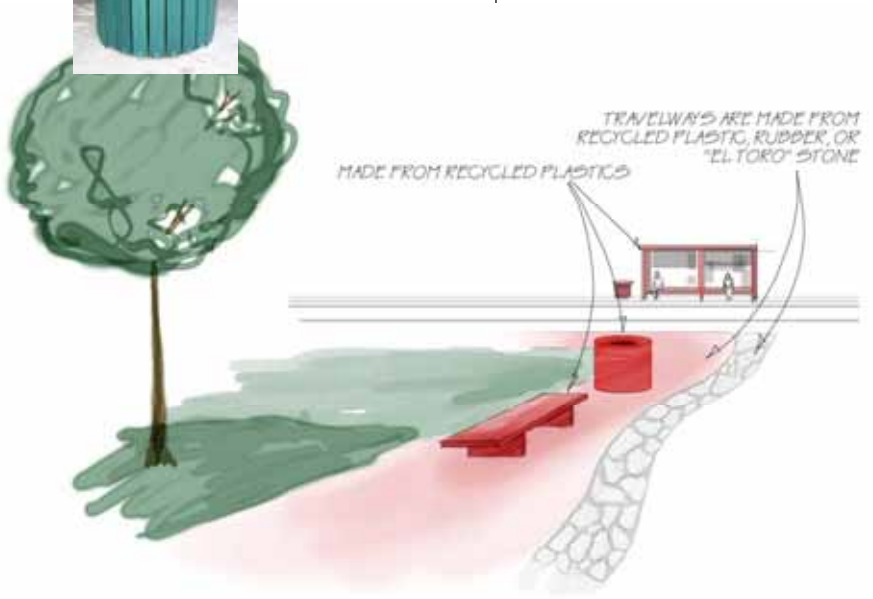
Application Criteria

- Recycled runway concrete and asphalt in road base; infiltration media for swales and treewells; subdrain blankets; paver block compositions; and drainageway gabions
- Use of "El Toro Stone" for slope retention and as pathway stones
- Rubberized asphalt pavements using tires and rubber waste are encouraged for durability and noise reduction
- Green waste composting for fertilizer and organic soil amendments in parkways medians, and adjoining landscape areas

[1] Association of General Contractors of America. *Concrete*. 2006. AGC of America. March 19, 2006. http://www.agc.org/page.ww?section=AGC%27s+Recycling+Fact+Sheets&name=Concrete

Use of Recycled Materials





5. INTEGRATED RUNOFF TREATMENT

Capabilities

- Water quality improvement/treatment at source
  - Increase sediment entrapment and reduce runoff velocities
  - Nutrient and metal uptake
  - Decreased runoff temperatures and reduce bacteria growth
- Harvest runoff for landscape and habitat
- Replenish groundwater
- Meet State/Local NPDES permit requirements for Clean Water Act

Information

- The following table shows various efficiencies for runoff treatment[1]:

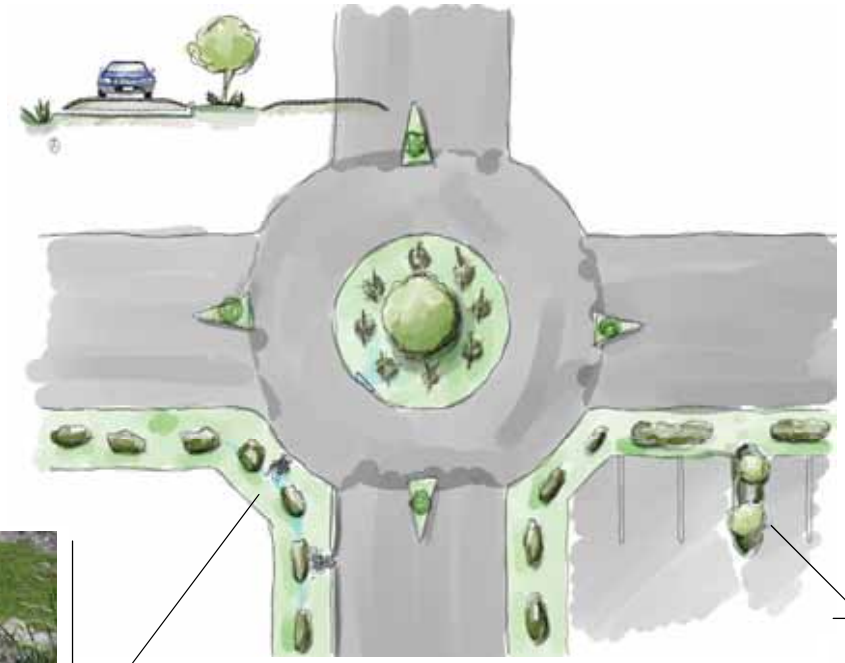
Removal Efficiencies (% Removal)							
Study	**TSS**	**TP**	**TN**	**NO_3**	**Metals**	**Bacteria**	**Type**
Caltrans 2002	77	8	67	66	83-90	-33	
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46– 73	-25	grassed channel
Harper, 1988	87	83	84	80	88– 90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988	81	17	40	52	37– 69	-	wet swale

Application Criteria

- Bio-swales planted with "uptake" vegetation for biofiltration (nutrient and metal removal)
- Utilize inverted median and parkway swales, round-a-bouts, and parking islands for stormwater infiltration and treatment where appropriate (level gradients with appreciable tributary areas away from building foundations and structures)
- Planted infiltration/exfiltration trenches; vertical subdrain columns; gravel blankets and pits for treating percolating runoff as it returns to groundwater
- Utilize Bio-infiltration landscaping to collect and treat stormwater runoff while allowing infiltration and replenishment of groundwater
- "Bottomless" catch basins and perforated pipe subdrain systems to collect and infiltrate or convey low-flow runoff as site soils and proximity of structures dictate

[1] Orange County Stormwater Program. *Appendix E1, BMP Effectiveness and Applicability.* June 2005. Pg. E1-61.

INTEGRATED RUNOFF TREATMENT



Recessed Parking Islands

Vegetated "Bio-Swale"

6. CONSERVATION ORIENTED PLANTING PALETTES

Capabilities

- Cost minimization
  - Reduce installation, maintenance, and green waste production costs
  - Reduce maintenance/care through use of more naturally self-sustainable species
  - Reduce irrigation demands
  - Reduce use of fertilizers and other chemicals
- Increase habitat compatibility and biodiversity through use of endemic and other appropriate plant species
- Creation of recognizable habitat for native fauna
- Improve aesthetics – Native and other site appropriate plant species maintain Southern California's landscape heritage

Information

- Energy, materials, and resource cost reductions for non-ornamental species
- Up to 70% of water used by residential communities in California is for external purposes such as landscaping.[1]
- "Native plants, once established, require very little to no additional water beyond normal rainfall. Also, because they are adapted to local soils and climatic conditions, native plants commonly do not require the addition of fertilizers and are more resistant to pests and disease."[2]

Application Criteria

- Recommend "California Friendly" plant selection
- Evaluate native plant palettes, massing, density, and proximity to structures as it may influence fire potential
- Align plant palette with soil type and chemistry as well as hydrogeology
- Array planting materials for full ground coverage
- Consider artificial turfs and synthetic planting where effective such as heavy foot traffic or play areas or integrated with planters and parking island planting; etc.

[1] California Department of Water Resources Planning and Local Assistance. *California water and Land Use. Statewide.* California Department of Water Resources. March 22, 2006. http://www.landwateruse.water.ca.gov/annualdata/urbanwateruse/2001/landuselevels.cfm?use=8

[2] United States Environmental Protection Agency, "Water Efficient Landscaping: Preventing Pollution and Using Resources Wisely". March 22, 2006. http://www.epa.gov/owm/water-efficiency/final_final.pdf

Conservation Planting Palettes

Drought Tolerant

Native Southern California

Artificial Grass

7. Structured Soil Preparation

Capabilities

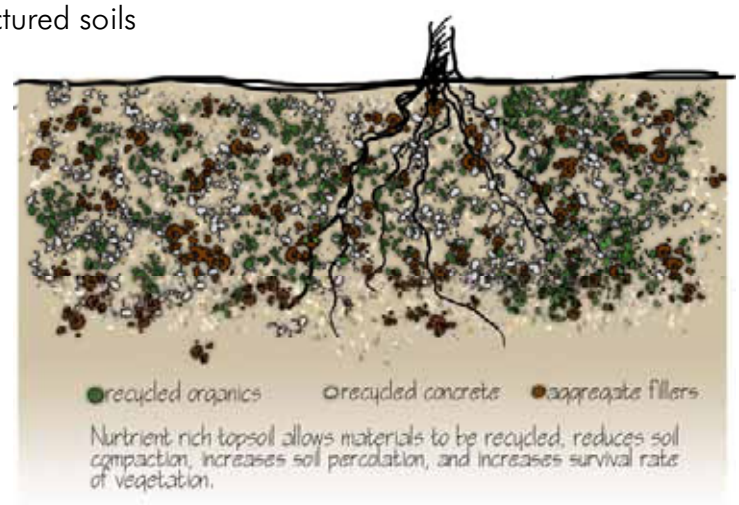
- Reduce runoff
  - Increase soil percolation
  - Increase water storage
- Locate and conserve valuable topsoil for agriculture and heavily planed environments
- Optimize aeration, infiltration, and organic productivity through blending engineered soil structure into fills
- Reduce tree root hardscape conflicts by providing root volume space with structured soil
- Increase survival rate for vegetation

Information

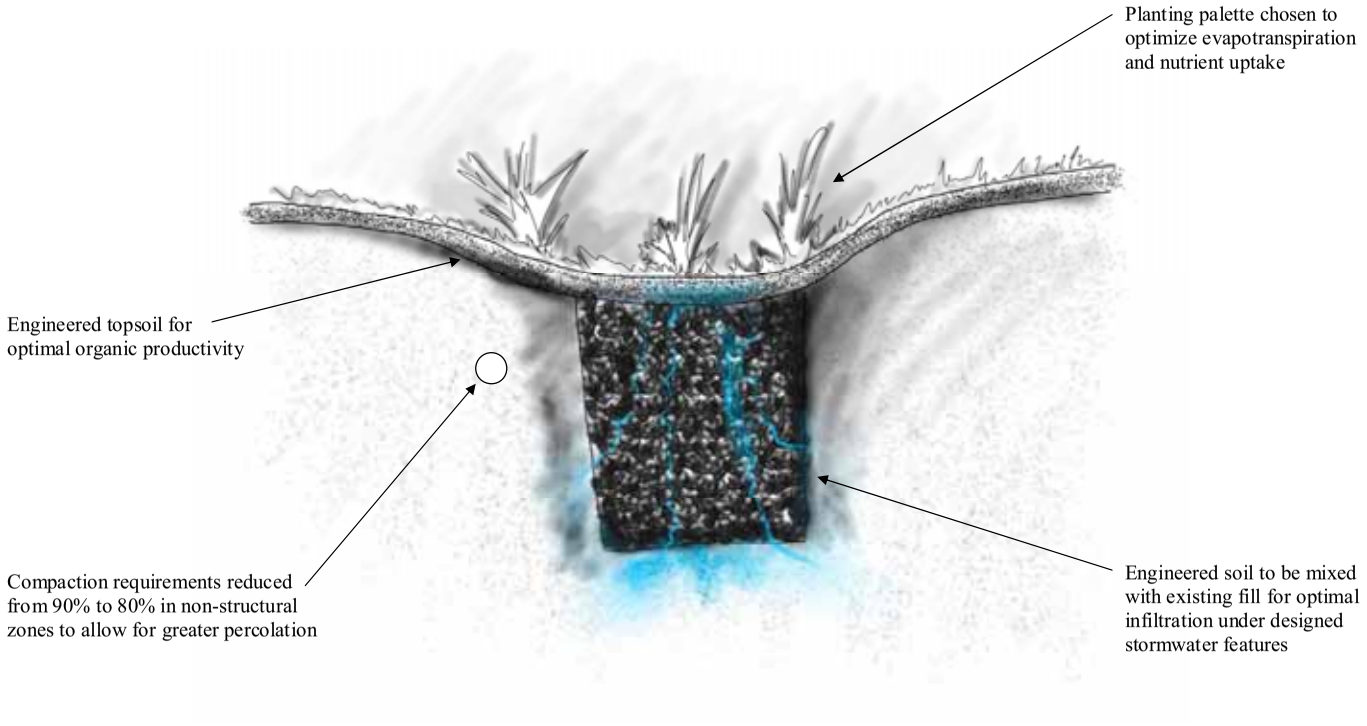
- Control acidity and alkalinity so soil has a neutral pH
- Resists erosion and nutrient loss
- Aggregation influences water movement into and through soil
- Minimize soil compaction wherever possible
- Earthworm channels create macropones, which improve soils permeability and aeration

Application Criteria

- Blend nutrient rich topsoil or recycled organics in targeted planting areas, such as agriculture plots; urban forests; perimeter planting screens; entry monuments; and large setback or parkway zones
- Increase soil percolation with sands and recycled gravels in flow lines and detention areas
- Reduce soil compaction requirements in non-structural zones from 90% to 80% to allow greater percolation rates and tree root growth
- Engineer structured soils to meet Proctor density requirements for road base materials
- Reuse aggregate from concrete deconstruction as a major component for structured soils



Structured Soil Preparation



8. REFLECTIVE COLOR/LIGHT VALUES

Capabilities

- Reduce paving temperatures
  - Reduce heat-sink effect of dark hues
  - Reduce ambient air temperatures responsible for Heat-Island Effect
  - Increase durability of roads (Figure 8.1)[1]
- Minimize reflective glare on wet surfaces
- Improve recognition of crosswalks, bus turnouts, and bikeways for public safety
- Improve aesthetics for "streets as public place"

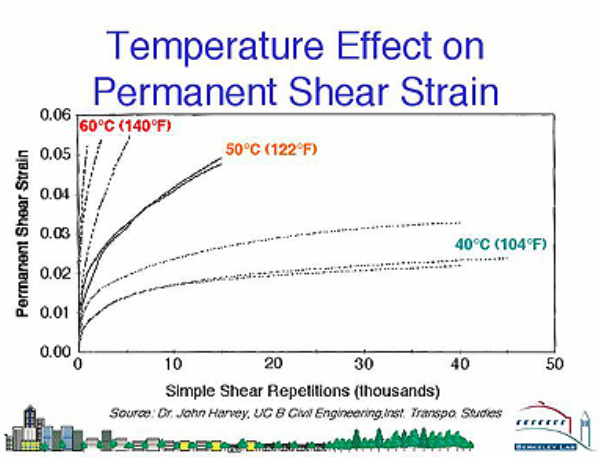


Figure 8.1[1]

Information

- The following table shows albedo ranges of typical pavement types.[2]

Pavement Type	Albedo (Reflectance)
Asphalt	0.05 – 0.10 (new) 0.10 – 0.15 (weathered)
gray portland cement concrete	0.35 – 0.40 (new) 0.20 – 0.30 (weathered)
white portland cement concrete	0.70 – 0.80 (new) 0.40 – 0.60 (weathered)

- Predicted $15M /yr in cooling energy savings and $76M /yr in smog-related medical and lost-work expenses for increasing albedo of 1250 km in Los Angeles by 0.25[3]

Application Criteria

- Distinguish trails, bikeways, turnouts, and transitways with colored AC or concrete
- Consider neutral concrete and asphalt colorings where aesthetics permit
- Consider coatings and applied "hi albedo" reflective surfaces to define bikeways, crosswalks, and turnouts

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[1] Pomerantz, Melvin. *Benefits of cooler pavements.* Heat Island Group. June 1999. http://eetd.lbl.gov/HeatIsland/Pavements/Overview/Pavements99-15.html. March 27, 2006

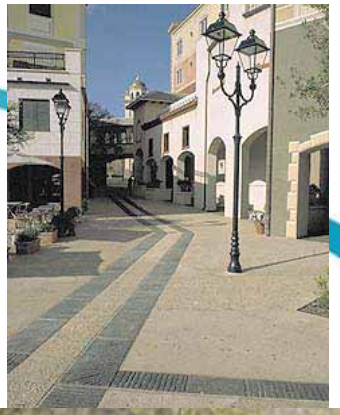
[2] American Concrete Pavement Association. *Albedo: a Measure of Pavement Surface Reflectance*. R&T Update concrete Pavement Research and Technology. No. 3.05, June 2002. http://www.pavement.com/techserv/RT3.05.pdf

[3] Pomerantz, M., H. Akbari, A. Chen, H. Taha, and A.H. Rosenfeld. 1997. Paving Materials for Heat Island Mitigation, Lawrence Berkeley National Laboratory Report LBL-38074, Berkeley, CA.

Reflective Color/Light Values

Conventional Asphalt Overlay

Asphalt Lightened by Color Additives



9. INTEGRATED TRANSIT OR NEV TRAVELWAYS

Capabilities

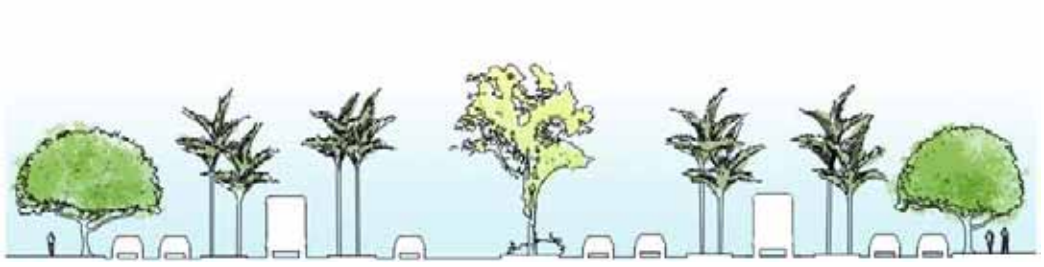
- Enable convenient, expedient, and efficient alternatives to car use within the Great Park and Great Park Communities
  - Reduce air pollution
  - Reduce traffic congestion
  - Reduce noise pollution
- Ensure equal or better travel time performance with immediate access
- Provide flexible travelways for future changes (e.g. outside car lane becomes NEV path or trolleyway)

Information

- Neighborhood Electric Vehicles (NEV)
  - Zero Emissions Ratings
  - City of Palm Desert Golf Cart Program produced reductions of nearly 4 tons of pollutants the first year and up to 16 tons of carbon monoxide annually by implementing NEV travelways within city infrastructure[1]

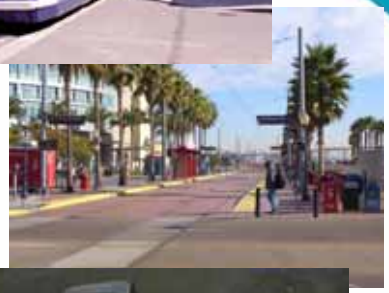
Application Criteria

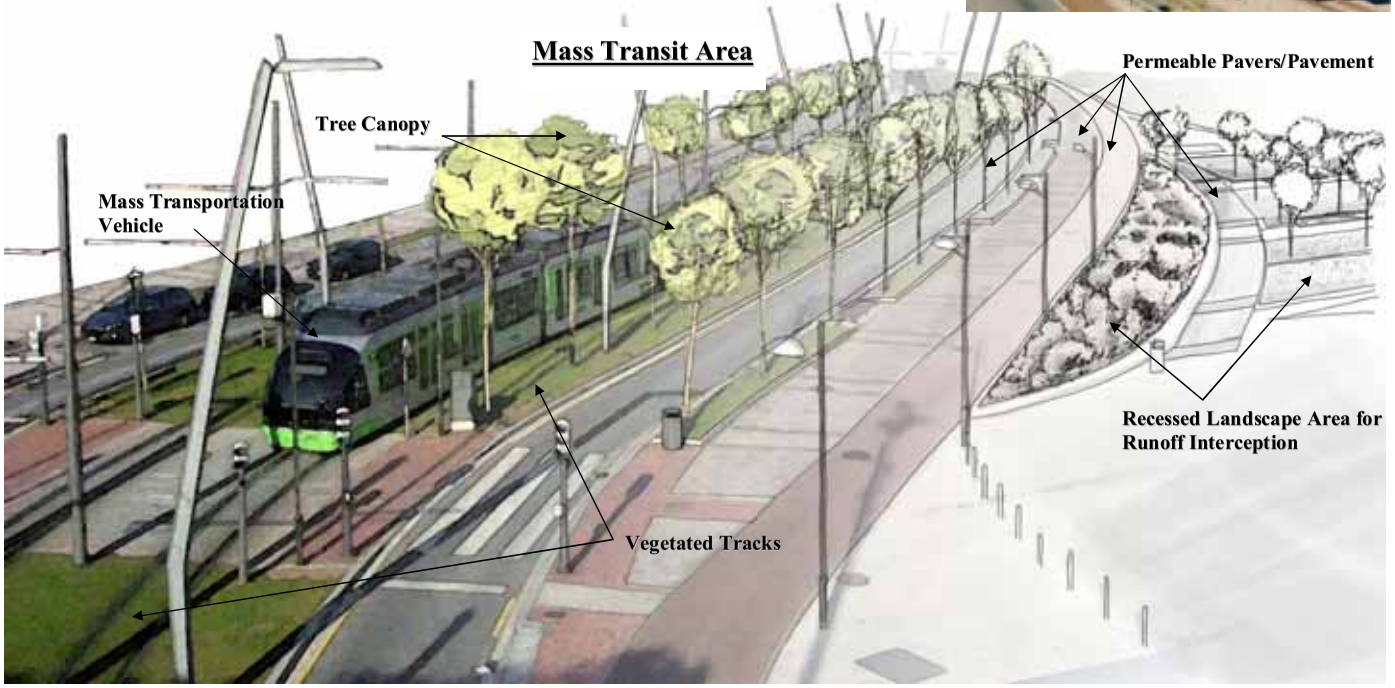
- Plan for alternative trolley/rail line network with equal or better "in community" performance and/or integrate dedicated travelway into vehicular streets for buses and future trolley/light rail
- Define pedestrian friendly paths, bikeways, and trails in concurrent network with streets (e.g. trails take you somewhere)
- Allow for expanded pathways with proportionately narrower vehicular lanes to enhance/encourage pedestrian use and aesthetics of "streets as public place"



1 Center for Urban Transportation Research. Golf Carts Making the Rounds in some Communities. University of South Florida. http://www.cutr.usf.edu/pubs/news_let/articles/winter98/win98-5.htm. Apr. 11, 2006.

Integrated Transit or NEV Travelways





10. Alternative Lighting

Capabilities

- Reduce "power grid" demand
- Reduce light glare and density
- Reduce light pollution/sky glow/trespass
- Improve aesthetics – nighttime star gazing

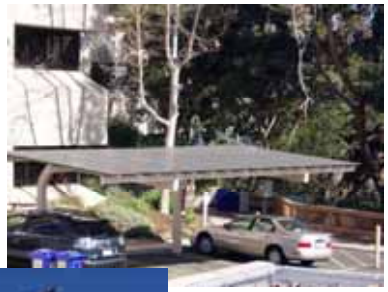
Information

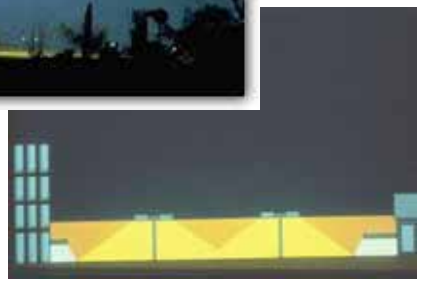
Application Criteria

- Consider district-level Photovoltaic (PV) source as economical/sustainable alternative power source
- Specialized PV powered fixtures for pathway lighting and signage in rural/meadows areas of Great Park and golf area of Great Park Communities
- Specialized PV installations invited for isolated bus bench structures; entry signage/gating and remote buildings along park pathways
- Consider PV sourced low level (12V) lighting for landscape lighting
- Consider building lighting contribution when evaluating public street or parkway lighting requirements
- Consider full-cutoff and semi-cutoff fixtures for reduction of light pollution/sky glow/light trespass
- Consider reduced illumination requirements at select locations
- Consider Security Code and Public safety criteria
- Consider light source such as light emitting diodes (LED) as an alternate lighting source

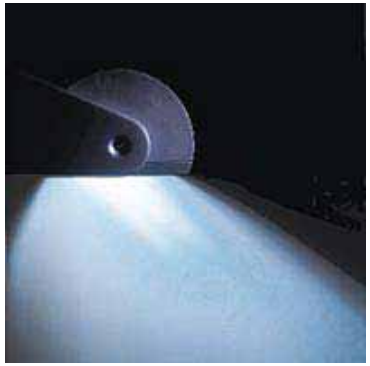
Alternative Lighting

Photovoltaic Lighting





LED Street Light



Full Cut-off

11. TRAFFIC CALMING FEATURES

Capabilities

- Improve driver and pedestrian safety
- Improve fuel conservation
- Reduce emissions/air pollution
- Reduce noise pollution
- Reduce traffic congestion
- Improve aesthetics – "enhance streets as public places"

Information

- Conversion of intersections to round-a-bouts has lead to a:
  - 39% decrease in accidents[1]
  - 76% decrease in injury producing accidents[1]
  - 90% decrease in fatal accidents[1]
- Reduce traffic delays by up to 75 percent with round-a-bouts[1]

Figure 11.1

Application Criteria

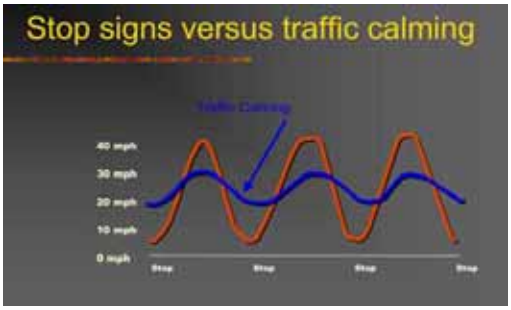


Figure 11.2

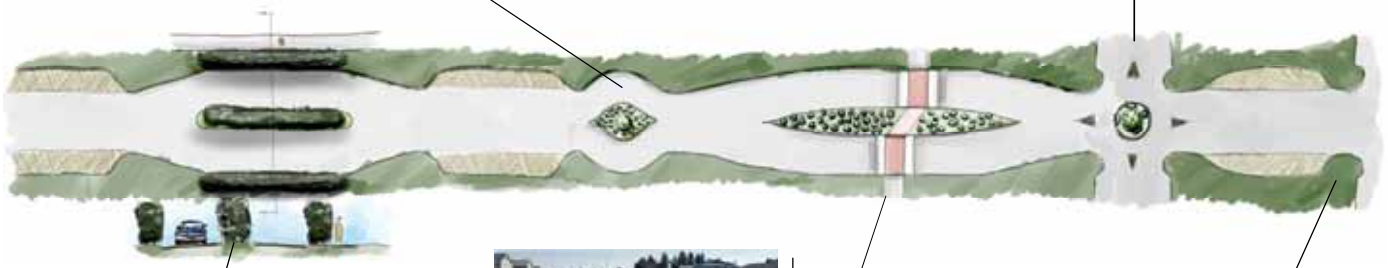
- Consider implication of traffic calming features and applications in conjunction with emergency response demands
- Enhance major street intersections with tapered curbing to create locations for "chance encounters" and improve safety of pedestrian crossings
- Intersection curb returns "expanded" at local and neighborhood collectors with specimen trees
- Opportunity for landscape "micro gardens" or water quality wetlands at intersections
- Periodic travelway curb tapers to "choke" perceived travelpath; enhance curb-separated sidewalk safety; and organize parking zones
- Create a network of short, walkable blocks (400-600 ft) to diffuse and slow traffic
- Consider requirements for maintenance, such as street sweepers, when designing traffic calming features
- Invite flared and rolled curbs to provide "softer" edges enhancing "streets as public place" with large landscaping, mid-block chokers, and islands at centerline

[1] Insurance Institute for Highway Safety. *Roundabouts.* Status Report. Vol. 35. No. 5. May 13, 2000

TRAFFIC CALMING FEATURES

Small Medians

Round-a-bout



Refuge With 45° Crosswalk

Chokers

12. REDUCED PAVEMENT WIDTHS

Capabilities

- Traffic calming
  - Improve fuel conservation
  - Reduce emissions/air pollution
  - Reduce noise pollution
- Reduce impervious surfacing in favor of expanded parkways for infiltration, shade, tree planting, and pedestrian friendly environment
- Reduce heat-island effect and pollutant runoff with interrupted or non-contiguous surfaces

Information

- Reduced pavement widths slow traffic and saves lives
- Water quality is enhanced when impervious surfaces are minimized
- Streets account for an estimated 40% to 50% of the impervious coven in development areas
- The U.S. EPA encourages the construction of streets without curbs to allow the use of "engineered" grass swales in certain situations

Application Criteria

- Utilize integrated fire protection system design approach when considering narrow street alternatives
- Modify travelway widths and curb geometry (e.g. islands, cul-de-sacs) subject to solid waste and moving service heavy duty vehicle requirements
- Integrate planted islands and medians in local or neighborhood level streets with focus on intersections (e.g. traffic calming effect, shade, infiltration)
- Reduce local, neighborhood and community level roadway widths with enhanced medians, parkways, and curb tapers for sustainable features
- Offset reduced pavement widths with widened medians of grouted recycled concrete or pavers for OCFA access (must be an OCFA approved alternative driving surface)
- Refer to OCFA Fire Protection Appendices for additional application criteria and requirements.

Reduced Pavement Widths

Prepared by

FUSCOE ENGINEERING

13. DEFINITIONS

Albedo – the ratio of reflected solar radiation to the total amount of incident solar radiation that falls on that surface. Albedo values range from 0, for perfect absorbers, to 1, for perfect reflectors.

"California Friendly" Plants – Plants that require little to no supplemental irrigation. Native and draught tolerant species are considered "California Friendly" plants

Dry Swale – A vegetated stormwater conveyance system designed to treat water quality that is typically wet only during infrequent rain events

El Toro Stone – Large pieces of concrete rubble from the deconstruction of existing infrastructure at the El Toro Marine Corps Air Station. This concrete to have natural break lines or rough cut edges to be used as the defining edge of travelways and as paving materials.

Endemic – Prevalent in or peculiar to a particular locality or region

Factor C – Relative imperviousness values for slopes of 1-2 percent

Grassed Channel – A vegetated stormwater water conveyance system that has not been engineered specifically for water quality

Group A Soils – A soil classification from the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) that encompasses soils that have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission.

Group B Soils – A soil classification from the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) that encompasses soils that have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission.

Heat-Island Effect – Tendency of urban air to increase in temperature due to solar heating of infrastructure

N – Nitrogen, a chemical element and nutrient, capable of polluting waters when present in excessive amounts. Common compounds of nitrogen include ammonia, nitrate, and nitrite. A primary source of excessive nitrogen is from the runoff of fertilizers.

P – Phosphorus, a chemical element and nutrient, responsible for eutrophication and algal blooms when present in excessive amounts in water systems. A primary source of excessive nitrogen is from the runoff of fertilizers and pesticides.

Telemetric "Smart" Controller – Irrigation controller that adjusts watering schedule with up-to-date information regarding various conditions such as weather and soil moisture

TSS – Total Suspended Solids, a quantitative measurement used in stormwater treatment which represents the amount of filterable solids within a water sample.

Wet Swale – A vegetated Stormwater conveyance system designed to treat water quality that maintains a wetland assemblage due to high groundwater levels and frequent rain

This is provided as an example of what OCFA requires.

OCFA Evaluation of BIA Proposals on Traditional Neighborhood Design/Traffic Calming Measures

November 16, 2000

INTRODUCTION

The OCFA has researched "traditional neighborhood design" concepts as proposed by the Orange County Building Industry Association's (BIA). The BIA presented an overview of neighborhood benefits and various street designs to the OCFA Executive staff and the Board of Directors with the request to incorporate elements into future developments within Orange County.

The OCFA evaluated proposed street designs aimed at "calming" traffic relative to the impact on community safety. While we realize that there are other important considerations such as traffic flow, density, street sweeping, trash collection, bus service, etc., only impacts to the delivery of emergency fire and medical services were examined. OFCA staff held numerous meetings with the BIA including tabletop exercises and actual field-testing. In addition, staff met with representatives from our partner cities to seek input on the street proposals.

OCFA street standards (width, turning radius, parking lanes, etc.) were developed to ensure emergency access routes to homes and other structures are available during emergencies. As a regional fire and emergency service provider, OCFA responded to 66,395 requests for emergency assistance in 1999 utilizing 152,876 pieces of equipment to a community that includes 431,193 dwelling units. Current OCFA street standards are among the lowest in Orange County (see Appendix A) and are designed to accommodate tactical operations involving fire apparatus that are approximately 10 feet wide and up to 44 feet in length. Our largest apparatus (aerial ladder/water trucks or "Quints") were not considered when developing these standards and the OCFA is currently evaluating other types of trucks.

In addition to results of research and field testing, a significant finding is the fact that TND incorporates street designs based on a grid system rather than a series of cul-de-sacs and collector streets. These grid and radial street systems with on-street parking, alleys, streetscape and short blocks of 500 – 600 feet provide fire apparatus with alternate points of entry and the ability to utilize various water mains when fighting fires. The probability of blocked access is decreased, as alternate routes are available. This grid design mitigates some of the negative impacts of narrow streets including slower response times, blocked access, limited tactical options, etc. Our recommendations will address this finding in more detail.

This report will cover components of a TND, current OCFA street standards, street standards proposed by the BIA, parking data, field test results and recommendations, other impacts and experiences in other jurisdictions.

BACKGROUND

Traditional neighborhood design is based on realities that existed prior to 1930. In addition to differences in community cultures, traffic flow and design of private vehicles, fire apparatus at that time were approximately 7 1/2 feet in width and carried only firefighting equipment. Today fire apparatus are up to 10 feet wide and carry equipment for a multitude of life and property saving operations. Stabilizers for the aerial ladders on trucks are 14 to 19 feet wide. These, and other realities, were included in the testing of various design concepts.

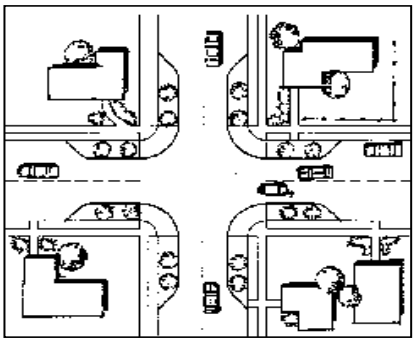
Design Concepts

The Institute of Traffic Engineers (ITE) generated a report in February 1994 describing traffic-engineering concepts developed for the Neo-Traditional Neighborhood Design (TND). The BIA included several of these concepts in the design proposals submitted to OCFA for consideration. Features of a TND design include:

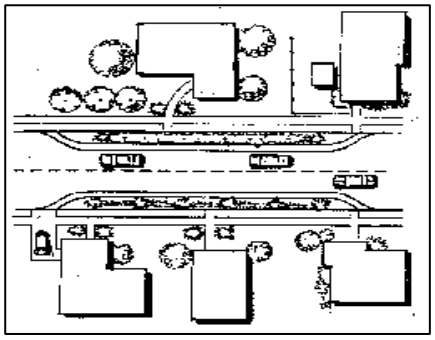
- **Accessibility** - Neighborhoods include mixed retail, housing, and other uses within approximately 5 minutes walking distance to other locations in the development.
- **Overall street design** - Dead-end streets are avoided by using grid and radial systems.
- **Alleys** - Fewer driveways off the main street allow more affordable small homes and more space for on-street parking.
- **Traffic calming** - Through street design and streetscape.
- **Street width** - Basic design includes two traffic lanes, one for each direction, and space for parking on at least one side. The resulting minimum width may be as narrow as 28 to 30 ft.
- **Street Trees and Landscaping** - Trees provide shade and lower street sidewalk temperatures.
- **Street Lighting** - Designed on a pedestrian scale to illuminate the streetscape rather than the roadway.
- **Traffic Signals** - May be required due to more connected streets and intersections.
- **Parking** - On street parking is encouraged.
- **Public transportation** - Designed to accommodate efficient bus routings through the neighborhood.

A true TND would have at least 3-4 of the design features listed above. The primary idea is to create a small town atmosphere, locating people within walking distance of parks, schools, retail and transportation services and with two means of access to every home.

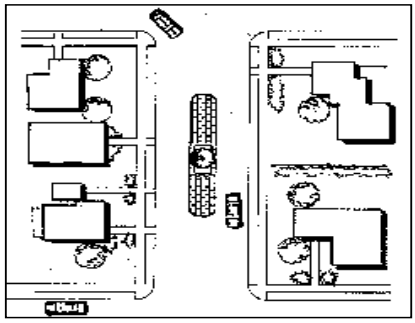
A key component of TND is traffic calming. This is achieved through the use of several street design features including:



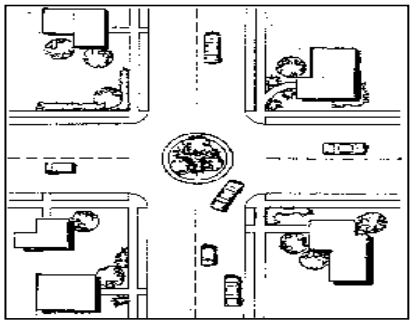
Corner Neckdowns



Tapers



Medians



Circles/Diverters

OCFA Involvement

The Irvine Company introduced OCFA Planning and Development staff to the TND concepts in January 1998. Later that year, the Rancho Mission Viejo Company began development of Ladera Ranch in South Orange County. As the various tracts were processed through the County Subdivision Committee, the developer worked with staff of the County's traffic division and OCFA on several alternate street design concepts. Each street design element was evaluated and several deviations were approved with specific mitigation measures required.

The BIA presented an overview of the TND concept to the OCFA Board of Directors (BOD) in March 2000. The Board directed staff to consider the proposals and report back with findings. As staff began research, the Aerial Apparatus Project Team created earlier in the year included street design elements in their evaluation of various apparatus and team members assisted in subsequent testing of proposed design concepts. There have been numerous meetings with BIA representatives over the past six months, including a tabletop exercise demonstrating emergency response needs.

Finally, staff worked with the BIA and Ladera representatives to conduct field-testing of selected street design scenarios. A full first-alarm fire response was simulated on streets painted to mimic those proposed for future construction. The results of those tests, including feedback from Operations personnel who participated in the testing, were discussed and recommendations were developed. Prior to presenting recommendations to the Executive Team, Planning & Development staff met with partner jurisdiction staff to seek input on the concepts and process prior to proceeding. Planning and engineering staff of our partner agencies expressed concerns with the process as well the potential impacts of changes on planning and zoning issues as well as other municipal services. They were assured that any changes would be processed through their respective city processes.

DISCUSSION

The various street design elements proposed by the BIA were field tested by OCFA Operations staff and the results and recommendations are presented below. Several assumptions proposed by the BIA were accepted when developing the scenarios tested. Some of these assumptions were later researched for validity and subsequently challenged. Results are presented at the end of this section.

Proposals Tested

1. Cul-de-Sacs

   Several design alternatives incorporating cul-de-sacs were tested including the standard 76' diameter bulb on both single and double-loaded streets, with and without parking in the 38' turning radius and with and without a center "island".

   Current OCFA Standard: Any bulb dimension that yields a 38' unobstructed turning radius and a 20' drive lane (28' in identified interface areas). Turning radius is not regulated for cul-de-sacs less than 150' in length and there is no maximum length for a dead-end street. In some cases, fire sprinkler protection for homes accessed off the "bulb" may be accepted as mitigation for parking and for center islands.

   BIA Proposal **1**: single loaded, 38' radius with no center island and with parking.

   Result: Operational space was somewhat compromised; apparatus were unable to make the turn and had to back out the length of the cul-de-sac; engines were able to make the turn although firefighters had to direct the Engineer; aerial ladder access to the roof was somewhat compromised by parked vehicles; and, redeployment would have been delayed and the risk of backing accidents increased (backing incidents account for 25% of fire vehicle accidents).

   Recommendation: 1) No parking permitted unless radius is increased to 46', i.e., no change to current requirement for 38' unobstructed turning radius. 2) Allow fire sprinklers to serve as mitigation for parking within 38' radius. 3) Establish a maximum cul-de-sac length' of 800' with allowance for greater lengths with mid-point turnarounds and fire sprinklers.

BIA Proposal **2**: double loaded, 38' radius with no center island and with parking.

Result: Apparatus were unable to turn around; ability of engines to make turn was dependent on where cars were parked; the aerial ladders were unable to reach the roof of the home.

Recommendation: See recommendations for Proposal 1.

BIA Proposal **3**: double loaded, 38' radius with center island with parking and 14' drive lane.

Result: The operational area was severely compromised making only one engine marginally effective; response time slower (drive and attack as well as resource deployment; medical and salvage operations also compromised); truck ineffective. No apparatus were able to negotiate the turn around the island although engines were able to turn in front of the island in a "Y" formation. Ability to turn in this manner was dependent on parking and would be impacted by "street furniture".

Recommendation: 1) Allow center medians only when all homes accessed from the bulb of the cul-de-sac are protected with sprinklers, a 20' drive lane (28' in SFPA) is provided and the turning radius is 17' inside and 38' outside. 2) Allow parking in cul-de-sac with 20' drive lane, rolled curb and landscape restrictions on island and with all homes protected with a full-coverage fire sprinkler system. 3) Allow center medians with a 20' (no parking) to 28' (fire hazard zones) drive lane and a "through street" emergency access way (sprinklers if turning radius compromised).

A 1997 r*eport by James E. West and Allen Lowe* offers recommendations regarding Eugene, Oregon's Land Use Planning. The report elaborated on the use of on-street parking and emergency service vehicles. Cul-de-sacs were of particular concern due to the potential for a blocked lane on streets with a single outlet. Dispatch practices of emergency service vehicles typically determine the order in which vehicles arrive at an emergency. If there is only a single outlet, some vehicles in the front of the line may be unable to turn around to transport victims to a hospital because of other emergency vehicles or parked cars.

2. Narrow Streets

Current OCFA Standard: 20' minimum width (28' in identified interface areas); parking lanes are a minimum of 8'; fire lanes required for streets less than 36' in width (one side posted between 28' and 36'; both sides posted on streets less than 28' in width).

BIA Proposal **1**: 25' single-loaded street with parking on one-side (17'clear width).

Result: Response was somewhat slower (approach and hose repositioning) but no other notable problems. Apparatus were not able to pass one another. Aerial ladder reach compromised but possible if 1st or 2nd on scene. May be more difficult with newer apparatus purchased due to smaller wheelbase and tighter turning radius (e.g. KME is 100" wide as opposed to previously standard 96" engine).

Recommendation: Allow 26' streets with parking on one side on grid street systems with maximum block length of 500' and with all homes protected with a full-coverage fire sprinkler system.

BIA Proposal **2**: 32' double-loaded street with parking on two sides (16' clear width).

Result: Similar to proposal 1 although cross parking further slowed response and limited positioning (no working room/door clearance between parked vehicles) and no apparatus were able to pass one another.

Recommendation: Allow 34' streets with parking on both sides on grid street systems with maximum block length of 500' and with all homes protected with a full-coverage fire sprinkler system.

3. Tapers (Medians and Eyebrows)

Current OCFA Standard: 20' to 28' street minimums with fire lanes (both sides on 20' streets; one side on 28' streets). Tapers, medians and eyebrows have been permitted for short distances and with sprinkler mitigation where warranted.

BIA Proposal: 18' and 20' wide tapers.

Result: Both widths work well as a single drive lane but restrict operations once apparatus positions in or near the taper. Passing possible but slowed in 20' tapers; not possible at 18'. Hydrant location impacted apparatus position.

Recommendation: 1) Allow with a minimum width of 20', posted "no parking", maximum length dependent on lot size and truck position/aerial ladder reach. 2) Allow sprinkler protection as mitigation for increased distance from required street width to homes due to medians/eyebrows. 3) Do not permit within 200' of cul-de-sac to accommodate hydrant placement. 4) Develop median set-back of 50' from intersections to accommodate turning.

4. Neck-down (bulb at intersections)

Current OCFA Standard: Turning radius of 38' outside (variations on inside).

BIA Proposal: 15' curb return.

Result: Turning was not a problem without vehicles parked on either street although centerline of street was crossed (would be a problem for non-emergency response vehicles). Engine connected to hydrants located on corners could obstruct later arriving apparatus.

Recommendation: Restrict parking within 50' of neck-downs and ensure hydrants are not required within 50' of intersections with this design feature.

Assumptions Challenged

The width of a parking lane and the number of vehicles parked on a street were provided by the BIA and used in the field tests. Based on feedback from Operations staff, these assumptions were further evaluated following the test.

Parking Lane Widths. The BIA proposes a 7' wide parking lane based on their study of average vehicle "track" widths of 4' 9" and the *average* parking distance of 7 ¼ inches from the curb. Trucks, recreational and sport utility vehicles are the most frequently sold vehicles and appear to be under represented in the survey. Measurements in the survey were made from the curb to the outside tire ("track") and did not include the vehicle body or mirrors. It is also important to understand that fire apparatus do not pass an *average* vehicle, they must be able to physically pass all vehicles on their route to an emergency.

The OCFA currently uses 8' as the required parking lane. This is based on the California Vehicle Code (CVC) description and local law enforcement enforces policies for fire lane enforcement. The CVC allows vehicle parking up to 18" from the curb. In addition, the Urban Land Institute (ULI) and Institute of Traffic Engineers recommend 8' as their standard.

On-street parking volumes. The BIA calculated the volume of on-street parking at .40 vehicles per dwelling unit. Operations personnel who participated in the field-testing expressed concern as to the validity of this volume. Battalion Chief Mike Rhode conducted a test using several engine/truck companies and identified actual parking ratios of .58 vehicles per dwelling unit. This represents a 45% discrepancy with the results used by the BIA. This may be a result of the socioeconomic status of newer communities in Orange Counties where households may have more than one vehicle per adult driver and where teenage drivers often also have their own vehicle.

RECOMMENDATIONS

In summary, the following recommendations are made:

1. Retain current street standards as adopted by partner city and County jurisdictions.

2. Discuss use of alternate street design standards with partner agencies on a development specific basis. Encourage an in-depth review by al affected service departments prior to implementation in order to avoid conflicts and ensure positive cost-benefit ratio. Relevant departments include public works, law, risk management, environmental protection and emergency services.

3. Utilize the revised street standard recommendations listed above in specific conditions with approval on a case-by-case basis. Factors determining applicability will include: response times and routes, street length, topography, and dead-end versus gird system design. Any deviations will be documented in a street design manual and will be applied based on specific findings made in conjunction with city/County staff.

4. Continue to require parking lanes at 8'; defer decisions relative to parking densities to city/County staff.

5. Establish a maximum length for cul-de-sacs of 800' and 500' for blocks in a grid system when streets are narrower than current standards.

6. Establish an maintenance/enforcement plan and evaluate effectiveness of alternate designs in achieving performance objectives.

CONCLUSION

OCFA evaluation of BIA proposals for Traditional Neighborhood Design/Traffic Calming Measure centered on response time needs for delivery of emergency services. Concerns regarding access to homes were validated in the tabletop exercise and the field test in the Ladera planned community. Although recommendations in this report mitigate some of the impacts, emergency response times, as well as ability to conduct firefighting operations and access homes to render medical care will be compromised.

The OCFA's concern for community safety includes any benefits of traffic calming cited by the BIA and other design professionals. However, research indicates that despite slower speeds, there is no decrease in accidents as a result of implementing these measures. In fact, ITE cites a 13% increase in collisions. Deputy Fire Chief Les Bunte of Austin Texas Fire used a detailed formula developed by Boulder Colorado scientist Ray Bowman and identified that at least 37 people would die because of slower emergency-response time for every one life saved by slower traffic. He used this formula in writing in master's thesis and only accounted for deaths from heart attack. Analysis of delayed fire response or response to other medical conditions could drive that number higher. The overall costs and benefits should be considered when making policy decisions that negatively impact the ability to deliver emergency services to our communities.

OCFA's findings were similar to those identified by other jurisdictions with experience with the concepts. Staff conducted several phone interviews to determine success in realizing benefits of design elements and areas for concern. Results of these interviews are included in Appendix B.

Appendix A

Orange County Street Standards Comparison

Table 1: Comparison of Fire Department Access Road Requirements (October 14, 1999)

	Minimum Turning Radius (feet)		Min. Street Width (feet)			Wildland Interface Areas
Jurisdiction	Inside	Outside[1]	Parking both sides	Parking one side[2]	No Parking[2]	
Anaheim	17	38	36	28	20	
Brea	NA	48	36	36	36	36
Costa Mesa	NA	46	36	28	28	No special stnd.
Fountain Valley	NA	38-50[3]	40	30	25	No special stnd.
Fullerton	NA	38	36	28	20	No special stnd.
Garden Grove	23[4]	43[4]	36[5]	28[5]	20[5]	No special stnd.
Huntington Beach	17	45	40[6]	32	24	No special stnd.
Laguna Beach	35	45	36	28	20	No special stnd.
Newport Beach	20	40	36	28	20	No special stnd.
OCFA	17	38	36	28	20	28[7]
Orange	25	45	36	28	20	No special stnd.
Santa Ana	20	40	36	28	20	No special stnd.

Notes

NA--Not Available

1. Outside turning radius is defined as the path of the vehicle's wheels. Some jurisdictions require additional turning radius beyond the outside tire to accommodate the bumper.
2. Requirements regarding the posting of 'No Parking' signs and/or red curbing vary significantly between jurisdictions.
3. Outside turning radius based on turning radius of the equipment at the nearest station.
4. A minimum cutoff corner required in addition to the turning radius. Dead-end access roads must also meet a 48 ft radius semi-trailer template.
5. Street width increases of 6 ft for dead ends.
6. Street width can be reduced to 36 ft if all homes served by the access road are sprinklered.
7. Street width may be reduced to 24 ft if the street serves three home or less AND is less than 150 ft in length.

Appendix B

TND Experiences of Other Cities

Appendix B: TND Experiences of Other Cities

Austin, TX

Street and streetscape design criteria for various types of streets are based on: Transit Stops, Typical Average Daily Trips Range, Design Speed, General Length, Minimum, Curb Basis, Right-of-way, Paving and Parking.

Example: The Mixed Residential Lane is a small scale, low speed roadway serving primarily single-family residential land uses.

One-Two Family Dwellings		Single-family, multi-family, apartments, etc
Typical ADT Range	less than 500	less than 1,000
Design Speed	20 mph	20 mph
General Length	less than ¼ mile	less than ¼ mile
Minimum Curb Basis	10’	10’
Right-of-way	46’	48’
Paving	26’	28’
Parking	2 sides	2 sides

Parking lanes are 8' in width.

Boulder, CO

The City has implemented several designs and installs traffic circles and speed bumps. There was a moratorium from 1996 until this year while the City addressed citizen and emergency response issues. The fire department developed a citywide map identifying critical response routes that are not eligible for design. The citizens recently put an initiative on the ballot, **“Seconds Count”**, which was also an issue in the Council election on November 7, 2000.

Portland, OR

The Portland Fire Department video, filmed in conjunction with the Sacramento and Chico fire departments, suggests that a grid system street designs and short blocks make narrower streets more user friendly for public safety. Specifically, they found that turning from a 24' wide road onto a 24' road is difficult due to the long tail swing on fire trucks, especially with parking, and recommend that tests be conducted with the biggest, longest, highest piece of equipment.

Following initial approval, a moratorium was placed on additional implementation pending review of citizen and emergency response issues. They worked with developers for 2 years to identify primary and secondary emergency access routes throughout the city. Traffic calming designs are approved based on several criteria once the access route is identified. However, following the lift of the moratorium, the city discontinued funding for installation of design measures.

Mountainview, CA
- Short block lengths are required on through streets.
- Compromised turning radius is recognized.

Chico, CA
- Bike lanes provide turning radius and a place for vehicles to pullover for emergency vehicles.
- Parking on cul-de-sacs is a problem.
- Grid system offers many options such as hydrants on various mains and various entries to a house.
- Round-a-bouts do not cause a significant problem.

Daly City, CA
The length of longest apparatus is 40'10" (Pierce Aerial ladder truck). The truck is 8 ft. wide and requires 16' to utilize outriggers (stabilizers). The wheel base is 240 inches.
- On local streets, the standard 36' width may be reduced to 32' provided parking is prohibited on one side.
- Turning radius into an alley (secondary access) is 20'.
- Turning radius on collector streets is 35'; Turning radius in cul-de-sacs is 52'.

Sacramento, CA
Greg Hoeger, CIS Coordinator, reported use the L.A. Public Works street standards with reduced on-street parking lanes of 7'. The fire department's request for larger parking lanes was denied by Council.
- Length of longest apparatus is 56'.
- Outside turning radius is 45'.
- Turning radius at intersections is 24'.
- Cul-de-sac radius varies with minimum of 34'; maximum length is 700'.
  Mitigation measure: Sprinklers when length of access exceeds 800' with no secondary access.

Santa Monica, CA
Policy Number 5-2 on Fire Access Road Requirements:
- Minimum clear width shall not be less than 20'.
- When hydrants are located on access routes, the minimum width is 26'.
- Turning radius is 39' inside and 45' outside.
- Dead-end access roads in excess of 150' in length shall be provided with either a 96' diameter cul-de-sac, 60' "Y" or 120' hammerhead to facilitate turning.
- Fire access roads between 20' and 26' wide must be posted as a fire lane on both sides.
- Fire access roads between 26' and 32' wide must be posted as a fire lane on one side.

Helena, MN
Longest fire truck is 40'; turning radius is 45'. Applicable on streets with less than 2,000/day.
- Minimum right-of-way of 48'.
- Minimum pavement width of 18' (21' measured from curb face to curb face). These streets are permitted only in residential neighborhoods that can demonstrate adequate off-street parking for visitors as well as residents.

- Parking lanes are 7' (State Standard).
- Cul-de-sac radius of 40'.

City staff was forced by city commissions and members of the community to reduce street widths but liked aesthetes of improvements. However, Phil Thompson with the Howard County Building Department said that the narrower streets "do not seem to be working". He referred us to Ken Byerly of the Fire Department who stated that neither the department nor the residents like the narrower streets. People are parking in areas they are not supposed to and there is considerable difficulty enforcing the no parking rules. He said that, as of yet, there has not been an incident that has been significantly impacted by the narrower streets.

This is provided as an example of what OCFA requires.

March 13, 2006

Green Streets Committee
Orange County Fire Authority Alternative Design Concepts

Purpose: This document was developed as part of OCFA's effort to identify alternative street design approaches for both the Great Park and Heritage Fields development areas. As a stakeholder in the development of these properties OCFA is committed to open dialogue of alternative street design standards.

Approach: In November 2000, OCFA prepared a report entitled "*OCFA Evaluation of BIA Proposals on Traditional Neighborhood Design/ Traffic Calming Measures*". A copy of this report has been provided to the Green Streets Committee. This report focused on alternative designs for residential communities. However, many of the same concepts were used as foundational elements for the features discussed in this document.

The approach used in the development of the alternative design concepts relies heavily upon enhanced building fire protection features that eliminate or greatly reduce the potential for significant structural fire events. This allows a reduction in the emphasis on the large number resources required to manage these types of emergencies and instead focus on medical emergencies and fires not involving structures (vehicle, rubbish, vegetation, etc).

Street widths and some traffic calming devices affect the ability of emergency service vehicles to quickly reach fires and other emergencies. Narrow streets lined with parked cars may not provide adequate spaces for emergency personnel to access and use equipment once they reach a scene. The California State Emergency Medical Services Agency and the Orange County Emergency Medical Services Agency guidelines provide that basic life support, CPR, and early defibrillation capable of first responder response should be 5 minutes or less. Advanced life support and emergency medical services response time should be 8 minutes or less. It is very important to designate primary response routes to minimize the overall impact to emergency response needs.

Assumptions: The concepts in this report are based upon OCFA's continued use of emergency vehicles with sizes and capabilities similar to those currently in service. OCFA continues to investigate the use of alternative vehicle designs for use within the Great Park. At this time equipment manufacturers have not been aggressive in developing green technology for fire apparatus. The implementation of alternative emergency response vehicles could allow further alteration of the design concepts presented in this document.

For the alternative design concepts in this document to be considered, OCFA made certain assumptions. These assumptions pertain to building design and construction requirements. Reductions in structural fire threat require that building designs include enhanced fire protection features, both passive and active in nature. The features include but are not limited to:

- All structures, regardless of size, will be protected with fire sprinkler systems designed for structure protection, except single family residences which will be equipped with fire sprinkler systems designed for life safety protection.
- All structures will be constructed as specified for not less than 1-hour fire rated construction. (*Note: Not applicable to single family residential structures*)

- Buildings will not exceed 2 stories in height.
- All fire sprinkler systems within commercial and multi-family residential structures will be monitored to off-site facilities who in turn will relay emergency signals to OCFA.
- All assembly, educational, multi-family residential and mercantile occupancies will be provided with alarm systems designed to notify occupants of the activation of the fire sprinkler system. (*Note: In lieu of an alarm system, an approved alternative method of accomplishing notification with single family residences will be acceptable to OCFA*)

A secondary but equally important assumption is that parking restrictions within the development areas will be actively, regularly and consistently enforced. Illegally parked vehicles will have a much more significant impact on emergency response capabilities with narrower streets. This is especially true as it pertains to medical emergencies. Parking design and enforcement programs are critical elements in the success of narrower street design concepts.

Street Designs:

Main Roads include entry portals and general circulation roads that allow for general movement within the development. These roads will not provide direct access to any structures. These roads should be designed for comparatively higher emergency vehicular response speeds. The layout design approach should provide for multiple routes to all areas served by these roads (preferably a grid layout). Due to the impact of obstructions on these roads, their design should be such that the potential for temporary obstructions is eliminated or minimized. Fire hydrant turn-out pockets could be utilized as described in Attachment A, in order to partially move emergency vehicles out of a traffic lane and improve the ability for additional emergency vehicles to pass.

	Current Minimum Req'ts.	Alternative Approach
Road	28' with parking 1 side	26' with parking on 1 side

Curb designs that allow for emergency vehicles to operate on the curb during emergencies can provide additional options to emergency response personnel and are encouraged by OCFA.

Medium Roads include roads that serve only specific geographical portions of the development. These roads will also not typically provide direct access to any structures. These roads should be designed for comparatively moderate emergency vehicular response speeds. The layout design approach should also provide for multiple routes to all areas served by these roads (preferably a grid layout). Fire hydrant turn-out pockets could be utilized as described in Attachment A, in order to partially move emergency vehicles out of a traffic lane and improve the ability for additional emergency vehicles to pass. If structures are located in such a way that firefighting or other emergencies associated with these structures rely upon the use of these roads to perform emergency functions, then some portions of the roads may need to be widened beyond the stated minimums.

	Current Minimum Req'ts.	Alternative Approach
Road	20' with no parking allowed 28' with parking on 1 side	16' with no parking and with 2' of alternative driving surface on each side = total of 20' 26' with parking on 1 side

Curb designs that allow for emergency vehicles to operate on the curb during emergencies can provide additional options to emergency response personnel and are encouraged by OCFA.

Small Roads are typically branch or frontage roads that provide direct access to a structure(s) or other activity center. OCFA's desire is that within the Great Park, these roads would have restricted vehicular access. Fire hydrant turn-out pockets could be utilized as described in Attachment A, in order to partially move emergency vehicles out of a traffic lane and improve the ability for additional emergency vehicles to pass. These roads could include dead-ends, if provided with appropriately designed turn-around. Because roads and other areas in the immediate vicinity of structures and facilities have the highest potential to impact emergency services operations, these spaces must be designed to minimize any potential restrictions to emergency vehicle movement. Even with high levels of built-in fire protection, personnel will still respond to alarms, fire sprinkler activation, medical emergencies, which require adequate space for staging and equipment movement. Therefore stated minimum widths are likely to be inadequate for portions of roads that are within 100-150 feet of structures.

	Current Minimum Requirements.	**Alternative Approach**
Road	20' with parking 1 side 28' with parking on 1 side	16' with no parking and with 2' of alternative driving surface on each side = total of 20' 26' with parking on 1 side

Alternate curb designs that allow for emergency vehicles to operate on the curb during emergencies can provide additional options to emergency response personnel and are encouraged by OCFA.

Turning radii: Current OCFA turning radii requirements were not considered for alternative designs.

Medians: When road medians are proposed, and if the design prevents OCFA emergency response vehicles from performing a cross-over maneuver, provisions should be implemented to allow cross-over for every 1000' of continuous median length.

Intersections: Parking restrictions must be in place and enforced within a minimum of 50' of intersections. Controlled intersections will be equipped with Opticom signal preemption equipment.

Attachments: Attachment A

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